Space Weather Technical Forecast

Issued on Thursday, 19 September 2024 at 13:05 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1/R2. S1 and G1 risks now reduced.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity measured by GOES16 and 18 has been Low, with isolated low-level C-class flares, the largest of which was a C3.0 at 18/1645UTC which emanated from AR3825, although there were almost overlapping contributions from both AR3824 and AR3829.

There are now five sunspot regions on the disc, with AR3830 no longer discernible in the northwest. The disc is dominated by two Zurich E-groups. Firstly, AR3824 in the southwest, which is apparently in decline but analysis is hampered by the narrowing viewing angle. Secondly, AR3825, which has a history of X-class activity and retains a small delta in its leading penumbral cluster, although the recent trend has been for spreading and slight depopulation of the westernmost penumbra. The most-changed group was perhaps AR3828 in the southeast, which saw development of several minor spots in the ambit of the main part of the group.

Note that there has been no NSO GONG H-Alpha imagery for the past 12 hours for the purpose of identifying filament lift-offs. A large upper-coronal dimming was however visible in AIA211 with a slight western solar hemisphere bias near 40-50N between 19/0600-1200UTC. This may correlate with ejecta becoming visible from the north of the occulting disc on Lasco C2 in recent hours. This will be analysed when more fully visible. This event possibly excepted, no Earth-directed Coronal Mass Ejections (CMEs) were observed.

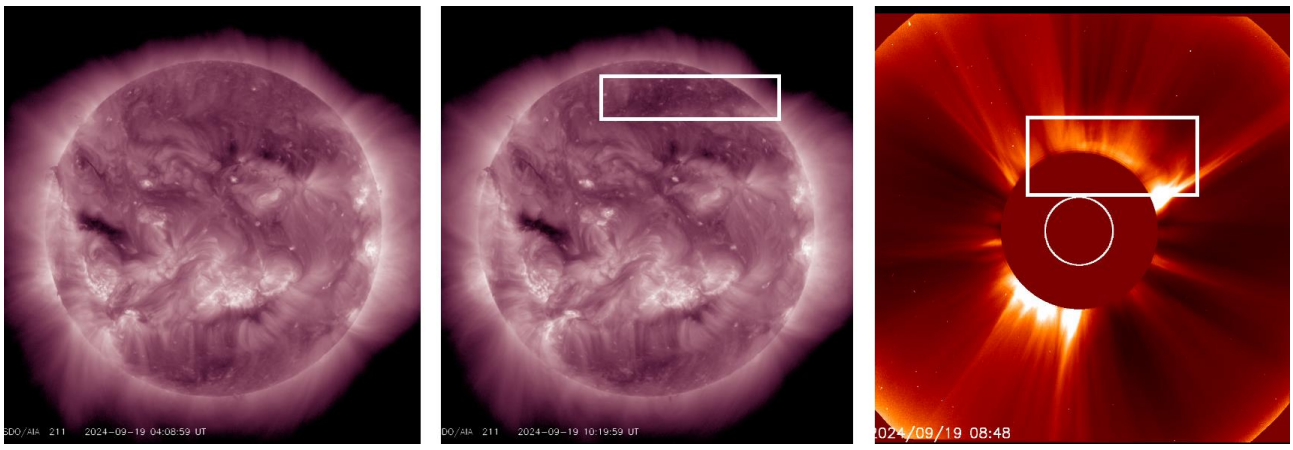

Figure 0: Possible high solar latitude dimming seen in AIA211 in current UTC morning. Possible resultant ejecta now becoming visible on Lasco C2, with analysis pending.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as observed by ACE at L1, showed a roughly level Slightly Elevated solar wind speed near 450km/s, with a positive phi angle (away from the Sun). This may still reflect waning 16 September CME influence, but with possible contribution from either CH70 or 71 (the former being more likely).

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The solar wind density remained within typical single figures ppcc. The IMF rose slightly to become Slightly Elevated into the current UTC morning at 9nT. The north-south component of the IMF varied between -8 and +7nT, with a erratic character aside from a more reliably anti-aligned period between 18/2100 and 19/0500UTC. The anti-aligned phase matched with an increase in geomagnetic activity, provisionally peaking at a Kp of '5- 'in the 00-03UTC interval.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 was below the S1/Minor Solar Radiation Storm level, steadily falling close to Background levels.

High energy electron flux (greater than 2MeV) observed by GOES16, generally varied on a diurnal cycle between Normal Background to Moderate levels peaking at 284pfu at 19/0255UTC. The associated 24-hour fluence initially increased but has since levelled off, with the 19/0001UTC observation being 9.01e6.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with a Chance of isolated M-class flares. There is a continued Slight Chance of an isolated X-class flare, most probably from AR3825.

Solar Wind / Geomagnetic Activity: No CMEs now feature in the forecast. Coronal hole influence should be minor and should wane by the end of the UTC weekend.

The daily Slight Chance of G1 should fall day on day due to initial waning 16 September CME effects and any fast wind enhancements from CH70/71, the former perhaps already in course. Activity should have returned to Quiet levels by the second half of the coming UTC weekend.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 will most likely remain at Background, with the daily risk of a Slight Chance of enhancement relaxing to raw values for the current disc. The most likely sources would be any significant flaring from AR3824 and then, increasingly, AR3825.

High energy electron flux is expected to see an overall rising trend, returning to reliably Moderate levels with peaks at High during diurnal maximum. The forecast is uncertain, but fluence values are anticipated to slowly rise into the period, with a peak Chance of rising above the Active threshold into Days 3 and 4 (UTC weekend).

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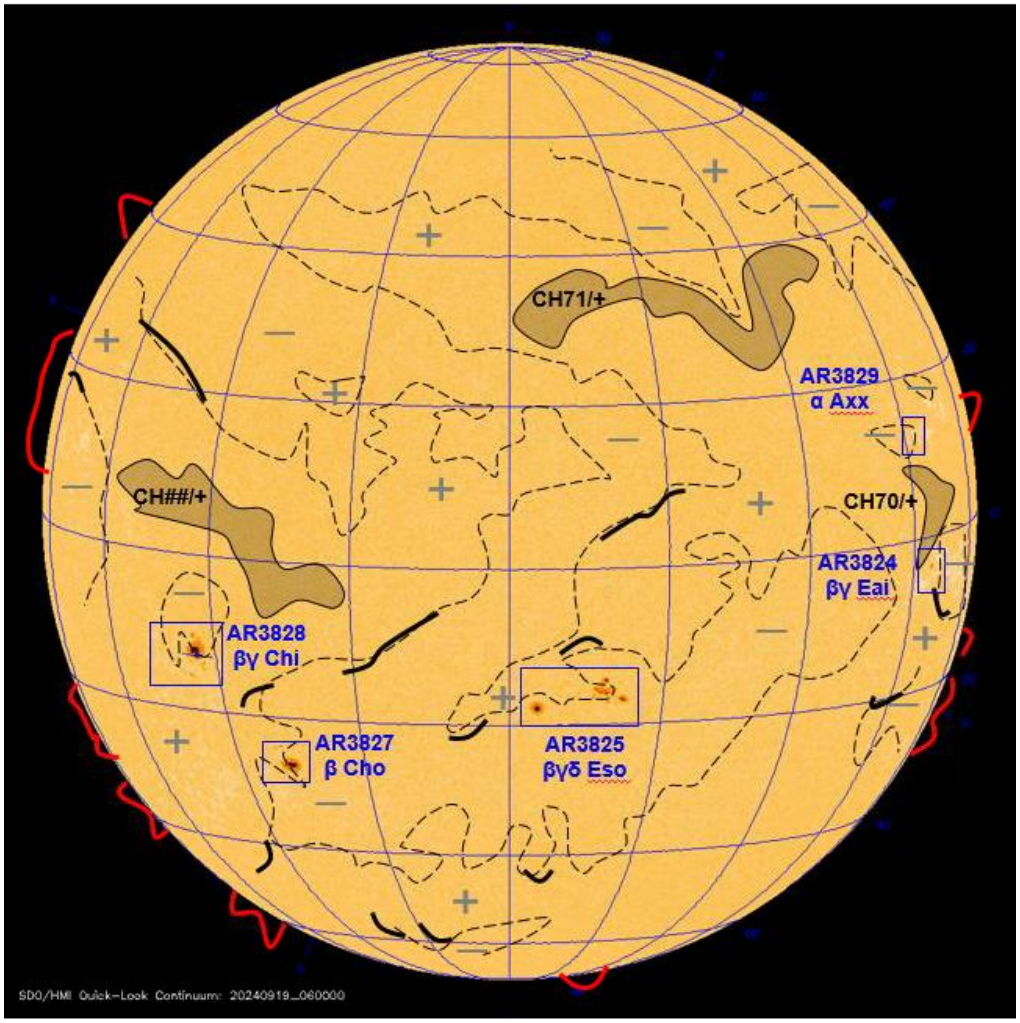
Figure 1. Solar Analysis Valid 19/0600UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

The only CME influence in the period is the tail end of the 16 September arrival, and this is now on the long end of duration estimates and should soon pass.

In terms of fast winds, a small positive coronal hole in the western disc (CH70/+) may provide some enhancement to the solar wind speeds at Earth for a time in the remainder of the current UTC day - indeed, it may already be in course. Following this, the larger but less 'directly-aimed' northern hemisphere CH71/+ may prolong the risk of geomagnetic activity, with glancing influence for a time from Day 2 (Friday 20 September). Influence from both of these features may see solar winds remaining at Slightly Elevated to Elevated levels, however speeds are expected to return to slow ambient levels by the end of the coming UTC weekend.

The daily Slight Chance of G1 should fall day on day due to initial waning 16 September CME effects and any fast wind enhancements from CH70/71. Activity should have returned to Quiet levels by the second half of the coming UTC weekend.

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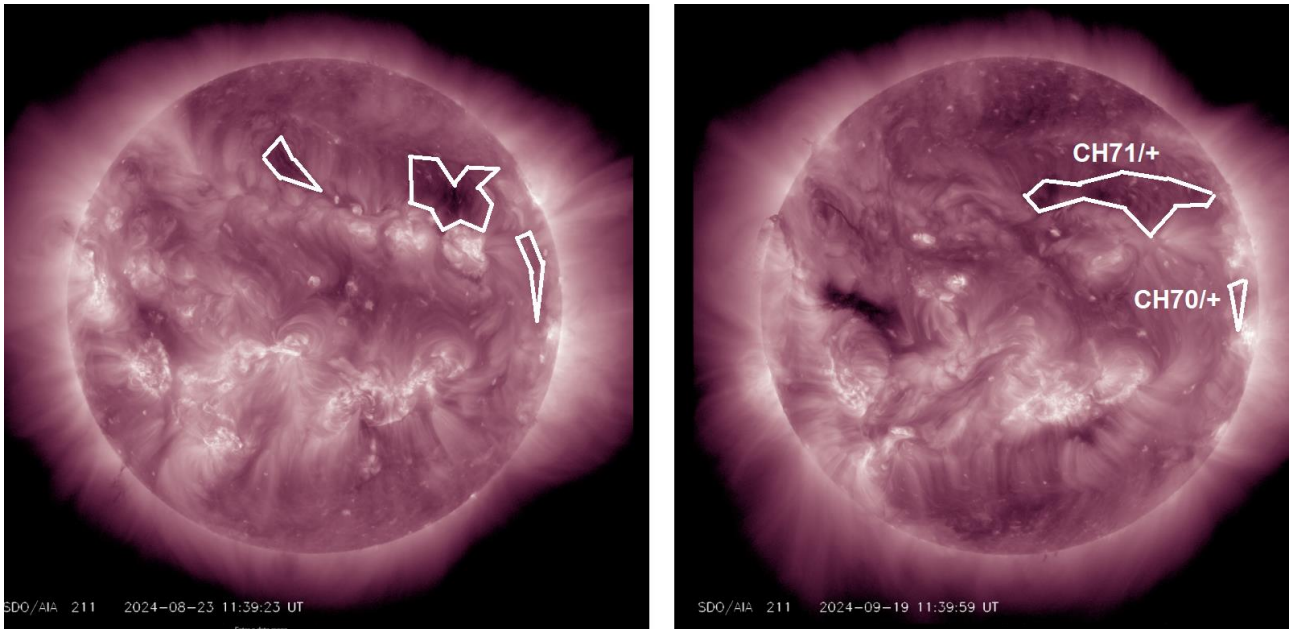
Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	20	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil, but note pending analysis.

Figure 2: Current and past rotations' coronal holes, showing rough correlation between passes. CH71/+ is judged marginal for any Earth effects, and CH70/+ is perhaps already underway.



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Radio Blackouts - X-Ray Flares:

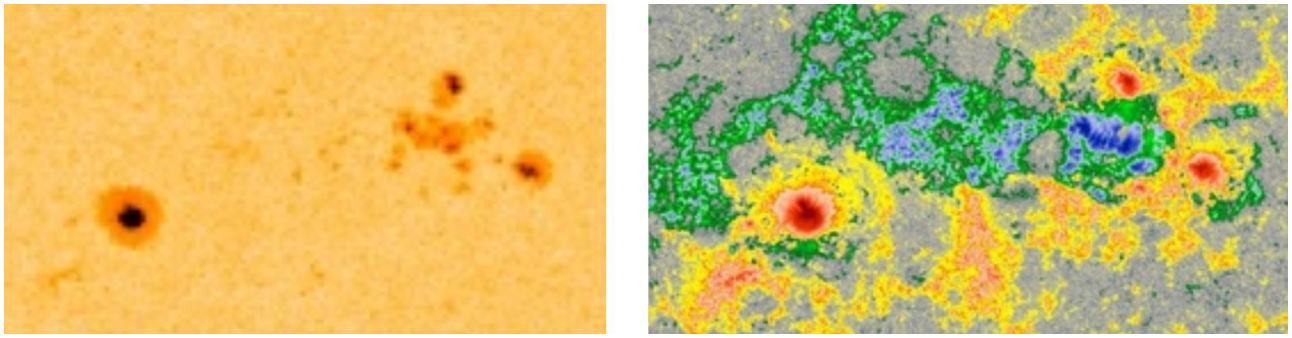
The current disc is amongst the least-populated sunspot region-wise in recent months, and the 10.7cm Penticton value is at a minimum for the past rotation (163sfu).

In terms of complexity, there are two main sunspot regions on the Earth-facing disc at present - the two Zurich E-groups AR3825, 3824, with perhaps an honourable mention for growing AR3828. One of these regions, AR3824 should cross the western limb later Day 2 (20 September) which should lead to a reduction in daily risks of significant flares. Recurrence and helioseismological mapping would however suggest that other regions may rotate across the eastern limb during this period, with some evidence that one of these (Ex-AR3807) may have played a part in a CME from this location in the past 24 hours, and is perhaps one to watch (although some of the CME appeared prominence eruption-like, i.e. perhaps less directly sunspot region-related).

Overall, M-class flare risk is rated as a slightly falling daily 'Chance' until Ex-AR3807 presents for analysis. The X-class level is maintained slightly above raw probabilities due to the history of X-class activity from AR3825 - the last such event being on 14 September.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	No	50	50	40	40
Very Active	**R3 to R5 X Class**	No	10	10	10	10

Figure 3: AR3825 in HMIIF and HMIBC at 19/1100UTC. The Mt Wilson delta spot candidate has now faded in its leading portion, although the penumbrae here have periodically connected.



Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES18 reached the S1/Minor Radiation Storm level during 17 September but has since declined and is now nearing resting Background levels. There is a chance of new enhancements during the forecast period following any significant flares, this would be more likely from AR3824 given its more favourable position in the western solar hemisphere. AR3825, in the southeast, also presents and increasing risk as a source in the event of any significant activity, having previously produced a proton response from 50 East.

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Overall, high energy proton flux levels are expected to remain at Background. A Slight Chance of enhancement from AR3824 and then AR3825 persists through the period, however.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	15	15	10	10
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: Past week in X-ray flux at GOES16, and resulting high energy protons at GOES18. The enhancement from the X4.5 from AR3825 on 14 September was perhaps enhanced by a C9.0 on the turn of the UTC day 17 into 18 September, and by the inbound CME from the X-class event. Levels are now nearing resting background and the daily risk is nearer the residual value for the current disc.

High Energy Electrons Event (≥ 2MeV):

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Following the arrival of the CME late on 16 Sep, high energy electron flux levels at GEO were suppressed to Normal Background. A form of recovery is currently underway, but has perhaps been interrupted by the G1 interval in the past UTC night, itself possibly magnetotail reconnection-related. Despite any hiatus, current fluctuations peaking within Moderate should be replaced by a rising trend with peaks at High during diurnal maximum, perhaps before the end of the current UTC working week. Having said this, there is a slight chance that potential HSS influence into the period it may act to further suppress and delay the electron flux recovery. This lowers confidence in the forecast values into the period.

The forecast is therefore uncertain, but fluence values are anticipated to slowly rise into the period, with a chance of rising above the Active threshold greatest into the coming UTC weekend. MOSWOC REFM is not considered to be offering significantly useful guidance given the dominance of recent CME influences.

GEO Electron Environment	**Level (cm^{-2} sr^{-1} day^{-1})**	**Past 24 Hours (Yes/No)**	**Day 1 (00-24 UTC)**	**Day 2 (00-24 UTC)**	**Day 3 (00-24 UTC)**	**Day 4 (00-24 UTC)**
Probability (Exceedance)			**(%)**	**(%)**	**(%)**	**(%)**
Active	**≥ 2 MeV ≥ $1x10^{8}$**	No	5	20	30	30
Very Active	**≥ 2 MeV ≥ $1x10^{9}$**	No	1	1	1	1

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